HOW WILL A SATELLITE REPEATER SYSTEM IMPACT RADIO

COMMUNICATIONS IN A LARGE URBAN AGENCY BY 2009?

A project presented to
California Commission on
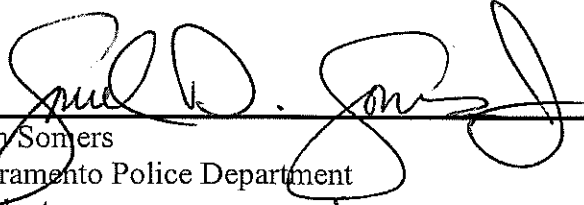Peace Officer Standards and Training

By

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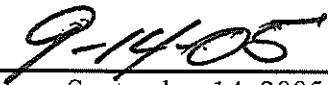Sacramento Police Department

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This project, written with the guidance and support of the student's agency and advisor, has been presented to and accepted by the Commission on Peace Officer Standards and training, State of California, in partial fulfillment of the requirements of Command College Class Thirty-six.

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CHAPTER ONE

ISSUE IDENTIFICATION

Introduction

The use of communication technology has become one of the most integral parts of day-to-day operations for any law enforcement agency. Specifically, wireless communication in law enforcement dates back over 75 years. In 1928, the Detroit Police Department first pioneered a one-way radio communication system by installing wireless handsets in the back of its Model T Ford patrol cars. This system had poor coverage and broadcasts often were interrupted or clarity of the broadcast was compromised when officers passed large structures, buildings or traveled under bridges. In addition, in order to use the frequency, which was designated for entertainment, and to obtain a license by the Federal Radio Commission (predecessor to the Federal Communication Commission), law enforcement agencies were required to play recorded music in between information broadcasts. Even with all of these shortcomings, this revolutionary system paved the way for the adoption of radio communication throughout the country.[i]

Since this milestone, wireless communication systems for public safety field personnel have continued to evolve. This evolution has witnessed the advancement of communication technology from these early, less-than-reliable one-way "mobile" radios to today's more reliable and efficient two-way trunked digital wireless systems. Today's radio technology not only transmits signals carrying voice communications but also visual data including photographs and video. This continued evolution has also seen the move by some agencies from using only radio frequency (RF) systems to data radios that use cellular modems. They have also moved across different frequency bands from the low band systems (VHF) to the higher bands (UHF) and

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ultimately where most agencies strive to be today, at the 800 megahertz bandwidth. Anytime law enforcement agencies decide to upgrade their respective communication systems, they must make a variety of infrastructure changes, significant financial investment, and most importantly a plan on how to make it all work.

The purpose of this project is to continue this advancement of law enforcement's communication technology. The current infrastructure for law enforcement's radio and data communications is land-based. This project will explore the feasibility of using satellites as a repeater system.

Radio communication systems can be broken into three basic components: the programming source, the repeater (and sometimes signal booster), and the intended receiver. Each of these elements can vary in the type of technology used to achieve the intended result, which is sending and receiving a message. In public safety, this first component in the communication chain would translate to a 9-1-1 or dispatcher center. The dispatch center is where most of the programming or emergency calls are received from the public and then transmitted out to the third component. This third component is the intended receiver or public safety officer's vehicle or portable radio. These positions alternate between being the sender and receiver and sometimes act simultaneously as both. Both rely upon the second element, which is the repeater system.

For the users of most radio systems, there is not much thought as to the importance of this vital link in the communication chain, which is the repeater antenna system. Even if significant investments are made in the technology for the receiver and sender, without a well designed and tested antenna system, the signal may not get to its intended destination. In fact, the quality of

the antenna system will have more impact on the quality of the communication than the quality of the radio system.[ii]

A basic explanation of how a repeater works is that it grabs the signal of the sender and then bounces it to its destination. This destination is the receiver that is located somewhere in the coverage area. This occurs whether the sender is standing in one location or moving rapidly throughout the coverage area. In some systems the repeater may also energize or amplify the signal.

Repeaters operate on a "line of sight" (LOS) principle. In simple terms, if something is between the sender, repeater, and receiver, the radio signal will have a degree of degradation. This includes buildings, hilltops, trees, just about anything other than air. Almost any radio signal will perform well if it has a LOS. Home satellite dishes get decent signals from satellites over 22,000 miles in space from very low transmitters. This occurs primarily due to being in the LOS.[iii] When there is not a clear LOS, degradation of the radio signal could result in dead spots or areas that cannot receive or transmit signals. A LOS path rarely exists in the real world, especially in a large urban city, which is why there is a need for repeaters. Prior to the placement of repeaters, consideration must be given to a variety of LOS obstacles to obtain the proper coverage. Some of these include:

- topography (highrise buildings or mountainous terrain)
- signal drop off
- interference (of other repeater signals)
- land availability
- new construction
- antennae height

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Each of these has an impact on how a system is set up, its cost, and ultimately its performance. Performance can be measured in many ways but dead spots, along with outdated equipment, are the most common and serious problems today with most law enforcement radio systems.[iv]

Statement of Issue

The purpose of this project is to discuss and identify how a satellite repeater system can become a reality and how to successfully implement this idea. The issue statement of this project is: *How will a satellite repeater system impact radio communications in a large urban agency by 2009?* This project would also involve the model agency contracting with a private vendor for building and launching the satellite repeater system. It would also require permission from NASA to launch and locate the satellite(s) at the desired location(s).

Satellite communication technology has been around for over 50 years. In its early years, this technology was primarily for military or government use. This has changed over the years and use of satellites has moved more into commercial use. Law enforcement has turned to satellites for some of its technology needs including satellite phones and the Global Positioning System (GPS). The military has continued to rely upon satellites as an instant communication source. It has provided the military with instant access to a viable and stable communication infrastructure under extremely difficult situations from the Gulf War to today's conflicts in Afghanistan and Iraq.[v]

As mentioned, wireless communication technology has continued to evolve. This evolution has also seen a diversification as new technology advances and gets rolled out. Wireless options currently available include radio, cellular, and satellite. These options are reflective of the past, the present and the future. Though radio technology is still in effect, it is

slowly being phased out as the newer technologies take hold and the bugs get worked out. Each of these technologies currently has advantages, but money being poured into older technology is not addressing the future needs of law enforcement, such as the ability to be interoperable.

With emerging technology at the satellite level, the public's desire for quality invisible wireless communication infrastructure and the push for both interoperability and homeland security, the time is right to move to create an infrastructure for the future that will address these needs. Other than voluntarily making this leap, there are a variety of ways that could push this upgrade in communication infrastructure forward. Two of these that stand out are: real mandates with funding and another failure by public safety at a high profile incident.

The federal government already has an unfunded mandate for interoperability on law enforcement agencies. Though even with this federal mandate, titled "FCC Frequency Application Process, Project 25 Interoperability Standards," only 36 % of the over 1300 agencies of over 100 sworn personnel surveyed by the National Institute of Justice (NIJ) planned to implement these standards with their next generation radio communication technology.[vi] The problem with this type of mandate is very basic. Some agencies do not have the budget to comply.

Another way improvements in communication infrastructure will occur is due to another high profile incident where public safety fails due to poor communication technology or interoperability. These high profile incidents include: natural disasters, terrorism, or an event that has a large loss of life or property. It is in these incidents that the true test of an agency's communication technology or interoperability occurs. These incidents require public safety agencies to work together to coordinated their responses. The Oakland hills fire of 1991, Columbine High School shooting, Oklahoma City bombing and the September 11th are real

examples of how poor or no interoperability cost lives and property.[vii] They are also the catalyst

that has pushed interoperability. However, without one of these occurring, small thinking,

parochial attitudes, and egos will continue to create fragmented communication systems where

public dollars are wasted and public safety will be at risk.

Environmental Scan

To help identify trends, event, and emerging issues related to the use and installation of

repeater systems, an environmental scan was conducted. This process required an examination

of five subject categories in order to gather information on trends and events that may impact the

use of satellites as a repeater system. The subject categories looked at were social, technological,

environmental, economic, and political (S.T.E.E.P.). The sources of information included, but

were not limited to, print media such as newspapers, magazines, reports, books, and journals.

Other sources included electronic media, television, radio, films, video, the internet, conferences

and formal and informal discussions with individuals and panel groups. These subject categories

are broad enough that they provide a representative framework on developments within society.

An assessment of the scanning process provided information in the areas of technological, social,

political, and environmental.[viii]

Technological

The Canadian Armed Forces, in a research paper on radio communications, determined

that satellite communication (SATCOM) was the only way to provide reliable, global

communications in a timely manner. They believed that current line of sight radios have neither

the range required nor the ability to operate in all topographical areas. In addition, during the

1992 Persian Gulf War, allied forces relied heavily on SATCOM resources for communications.

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Canada also looked to the period 2001 to 2005 as a window of opportunity when the US, Britain, and France would be replacing their existing X-band satellite systems and that it would provide an opportunity for communications cost saving through co-operative design, development and manufacture of space systems.[ix]

Currently the life span of a law enforcement communication system is 8 to 15 years (depending on the size of the agency and the cost of the system to be replaced).[x] Satellite life span is within this time frame with an estimated life of 8 to 12 years. The life span is contingent on factors such as the distance in space, battery size, and the amount of fuel for the thrusters. [xi]

According to an NIJ study, 70 percent of the over 1300 agencies with over 100 sworn polled stated that consideration of interoperability issues and standards was important to their agency when planning for the purchase of their next land mobile radio system.[xii] The study also determined the two largest obstacles to interoperability as "limitations in funding" and "different bands" or frequencies that agencies use. Most of these agencies often turn to "low tech" methods to overcome interoperability needs including posting representatives in dispatch centers to relay information or issuing mobile radios to other agencies. [xiii]

Social/Political/Environmental

A growing trend, which is becoming problematic for radio communications, is the need for and mounting challenges of the placement of necessary repeater infrastructure throughout a coverage area. The need is created due to the radio systems relying on the LOS principle. In an urban environment this LOS can be impacted with new construction. As most large urban cities have highrise buildings or are attempting to attract new business and highrise construction, this is creating problems for their respective law enforcement agencies. Highrise buildings create dead spot coverage issues and the need for additional funds for repeater installation to provide

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adequate coverage. Attempting to address these coverage issues creates a domino issue resulting in law enforcement being pitted against private sector companies over each others need for available tower, cell or antennae space. As private companies rush to secure locations for their communication technology, they create challenges to law enforcement agencies that attempt to either replace or improve theirs.[xiv]

The installation of additional towers to carry line of sight signals via repeater antennas or cellular technology is also becoming more difficult as residents are looking at the potential negative appeal these towers bring to their neighborhoods. These negatives fall into several categories from visual eyesores to perceived potential health risks. As public sentiments about these communication infrastructures are expressed more overtly, politicians have taken note and our jumping on this bandwagon.[xv] In Chattanooga, Tennessee, the local City Council restricted a cell companies tower size and threatened to not approve others due to the poor visuals these towers present.[xvi] In Beacon Hill, Oregon residents took to the street and held public protests using banners and bullhorns to express their dissatisfaction at the proposed installation of cell towers in their neighborhood.[xvii] In addition, California state legislation in 2000, preserved local control over the installation of cell towers therefore making it less politically attractive to force the installation when there is a need for coverage.[xviii]

Court battles between local communities and the private sector over cell towers further illustrate the difficulties faced when attempting to install, move, or erect repeater technology in someone's backyard. In *Cellular Telephone Co. v. Oyster Bay*, the town board attempted to stop AT&T from installing camouflaged cellular antennae on a water tower. The town provided no factual information on their decision other than public testimony as to their feelings about the towers. The court ultimately overruled the town board's decision, but the town board's decision

to litigate further demonstrates how politicians are not going to go against the growing sentiment

against these towers.[xix]

In another case, *Sprint Spectrum, LP v. Willoth*, Sprint sought site approval to erect 180

foot towers in a heavily populated area. The town's planning board hired a consultant who

guided them to request Sprint to do a variety of actions including an environmental impact report

and also to justify their tower locations versus alternative locations proposed by the board.

Sprint mildly complied with part of the requests and ultimately sued under the

Telecommunications Act of 1996. In this case, the court found in favor of the town board. This

was also a case of how local governments are becoming more savvy and more inclined to spend

money to hire experts to take on the issue of installing cell or repeater towers. [xx]

The research and scanning using the S.T.E.E.P. model indicates the push to erect

infrastructure to improve wireless communication is because the public wants good

communication coverage. The public wants public safety communications to be interoperable

and will not tolerate another public safety failure in a high profile disaster, due to poor

communication technology. What these articles and court cases tells us is they also do not want

to have visual eyesores, and they do not want the perceived health risks of having a cell or

repeater tower in their backyard. They want another option, which satellite repeaters may

provide. As such, the next chapter will detail a futures study for this project.

CHAPTER TWO

FUTURES STUDY

Introduction

The future impact of a satellite repeater system on radio communications in a large urban agency by 2009 cannot be predicted with any certainty. There are methods that allow researchers to identify significant trends and possible events that could impact strategies developed by a law enforcement agency.

The Nominal Group Technique (NGT) is a brainstorming process to extract information and opinions from a group or panel for any given topic. During an NGT, a group is led through the process of identifying trends and events that relate or may have an impact on a topic or issue. The panel, with the aid of a facilitator, identifies trends and events and then discusses, clarifies, and prioritizes their information.

An NGT panel was selected specifically for this project as a method to brainstorm for trends and events that could impact the issue statement "How will a satellite repeater system impact radio communications in a large urban agency by 2009?" Approximately ten days before the scheduled NGT, each panel member received a packet of information explaining:

✓   the purpose of this project

✓   the NGT process

✓   the issue statement

✓   the definitions of a trend and an event

The panelists were requested to come prepared to provide possible trends and events that could impact the issue statement.

The NGT panel consisted of nine members with diverse backgrounds and experience levels. Basic profiles of the panel were as follows (Appendix A):

> A civilian radio communications commander of an outside agency dispatch center with over twenty years of experience.

> A government information technology manager with prior private sector experience in the information technology field.

> A lieutenant in charge of managing homeland security for a large urban city including the procurement of technology to aid in this assignment.

> An executive director of a business partnership group.

> A police captain and Command College graduate with over twenty years of experience.

> A state OES communications manager.

> A Metro Fire communication supervisor.

> A radio communications technology supervisor who is part of a Joint Powers Authority work group currently preparing to purchase a new regional radio system.

> A police lieutenant currently assigned as a patrol watch commander with over fifteen years of experience.

There was also an administrative assistant to assist with note taking and to assist with general needs.

On the date of the NGT, after an initial ice breaking exercise, the facilitator reviewed the following with the panel:

- issue statement

- trend and event definitions

- the five S.T.E.E.P. categories (Social, Technological, Environmental, Economic, and Political)

- five different sectors (local, regional, statewide, national, international)

Trends

The panel was first asked to identify trends that related to the issue statement. Trends are defined as: a **series** of incidents or events taking place, that are gradual and long term, which seem to indicate a general direction in which a particular issue may be heading. It can be based on the past, present, or future, can be quantitative or qualitative and does not include a forecast.

The NGT was conducted in a round-robin format to ensure participation by all members and to try and eliminate the total influence of one member on another. After three rounds the panel generated twenty-seven trends (Appendix B). The group then was led through the prioritization process where they identified the top eight trends that would potentially have the greatest effect on the issue statement.

The panel next assigned a numerical value to each of the eight trends using the benchmark number "100" for the level it would possess today. These numerical values were given for the following time frames:

✓ five years previous to today

✓   five years in the future

✓   ten years in the future

The panel also assigned a number from 1(low) to 10 (high) to reflect the concern law enforcement should have with this trend relative to the impact on the issue of using satellites as repeaters.

TREND	-5 YEARS	TODAY	+5 YEARS	+10 YEARS	CONCERN 1-10
T1 The level of support for public safety communications funding	70	100	125	150	8
T2 Number of agencies looking at satellites as a repeater for law enforcement	15	100	125	175	7
T3 The level of space technology reliability	80	100	120	150	8
T4 Budget levels for state/ local government	100	100	100	125	10
T5 The demand for greater bandwidth for different device and distances	50	100	150	200	8
T6 Level of NIMBY for cell/repeater towers	80	100	150	180	8
T7 The amount of funding for the space program	100	100	110	115	6
T8 The merging of older and newer communications technology	100	100	150	150	8

Trend Table
Table 2.1

The top eight trends and their corresponding median values assigned by the NGT panel are depicted in table 2.1. The trends are listed in abbreviated fashion in column one. The values in columns two through five are reflective of the panel's opinions on the

direction the trend has and is moving relative to the issue. Column six is the level of concern law enforcement should have for the trend. The panel felt that Trend 4 (budget levels for state and local government) should be of the greatest level of concern for law enforcement. The panel also indicated that the Trend 5 (the demand for greater bandwidth for different devices and distances) would increase the most in ten years. They had the following discussions, in summary, about the top eight trends.

Trend 1 - The level of support for public safety communications funding

In the aftermath of the terrorist attacks on September 11, 2001, and the focus of the Office of Homeland Security in preparation for and prevention of future terrorist attacks, the panel felt there would be a steady increase in the amount of funding for public safety communications. They additionally tied this to the increased awareness of the ability to be interoperable with other public safety agencies from the various levels of government: regional, state, and federal. The group also discussed how there has been an increase in the amount and availability of grants that specifically address communication technology and that they expected this to continue to address improvements in technology. Though their concern was an eight, they felt confident that the importance of good public safety communication was well recognized by elected officials and this would keep the funding a priority.

Trend 2 - The number of agencies looking at satellites as a repeater for law enforcement

The panel discussed that there will be more agencies considering satellites over the next ten years, but it will be slow over the first five years. According to the panel

much of this slowness to considering this technology will be due to the spike in agencies using different technologies. This spike of varying technologies will incorporate the use of satellites from five to ten years out. The consensus of the panel was there would be a wait and see approach by law enforcement leaders as pioneering agencies work out the technological issues that satellites may present. The group concluded that satellites would be a viable option in the future, as technology improvements will overcome current shortcomings. The panel indicated that even with the trend making a fairly large increase it was or should be only of moderate concern for law enforcement due to this being the eventual future of communication for law enforcement.

Trend 3 - The level of space technology reliability

The panel believed that the reliability of space technology is already here. They felt there would continue to be gradual improvements in the technology and this will be tied to demand and funding. The panel did discuss that there was possible reliability issues with the older satellite constellations put in orbit around the earth in the 1980s or earlier. Overall the group felt that there are occasional failures, such as the two space shuttles that failed, but their confidence in the technology overall was high. The panel did conclude that law enforcement would look at reliability issues as a critical item before they will commit to this technology thus they felt the concern should rate an eight. They also discussed the increased uses such as satellite phone, radios, Global Positioning Instruments, and television services and its acceptance as the future.

Trend 4 - Budget levels for state and local government

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The panel felt that this trend should be of the highest concern for law enforcement and rated it a ten. The panel felt, as with all areas of government, without funding, programs and technology will not be continued or upgraded. As such, with no additional funding it would be difficult to upgrade current technology. The group was somewhat pessimistic on the short term as they felt there would be no change over the next five years. They felt that the current budget shortages have not hit the bottom, however they were cautiously optimistic that it would turn around in the next ten years.

Trend 5 - The demand for greater bandwidth for different device and distances

The panel felt that this trend will increase the greatest over the next ten years. They felt there will be a demand for more bandwidth by a variety of groups, both private and public, and that law enforcement will be included in that group. The group discussed the demand to put large data files over radio systems. A couple of panel members felt this trend will pose a problem for agencies who want to give mobile data information that may tax or overwhelm their systems. They also discussed that this may create a situation where radio bandwidths will need to be set aside for public safety to protect their availability. The bottom line for the panel on bandwidth was that it was not a significant issue now but in ten years would be, so now was the time that it needed to be addressed.

Trend 6 - Level of "Not In My Back Yard" (NIMBY) for cell/repeater towers

The panel believed that this trend was a double-edged sword. On the one hand, the general population wants increased and better coverage of the technologies that use cell/repeater towers. On the other hand, nobody wants it in their back yard. The panel

discussed the increased amount of politics encountered to erect towers and that it was becoming tougher to do so. Some of the greatest concerns the panel felt most citizens held, centered around the aesthetics and perceived health risks. The panel members expressed concern that, for the current infrastructure to function correctly, there would need to be an increase in the placement of these towers. The panel however believed there are emerging options to overcome the objections of these type of towers. The two technologies that were discussed were satellites and "mesh." The panel described mesh technology as a small repeater system that could be affixed to telephone or light poles to carry radio signals around large buildings or obstructions. The group consensus was that as these technologies continue to advance they would eventually replace the cell/repeater towers.

Trend 7 - The amount of funding for the space program

The panel felt this trend had the least amount of concern for law enforcement as it related to the issue statement. The panel felt that funding in this area would gradually increase though there were some varying discussions to the contrary. The alternate view by panel members was that budget cuts would directly impact innovations that come out of space technologies. Communication technology advancements was discussed by the panel as one area that could be impacted if there were any cuts to the space program.

Trend 8 - The merging of older communications technology with newer communications technology

The panel felt the merging of older and newer communications technology would continue to increase for the next five years and then level out. Part of this increase over the first five years was related to the desire of public safety to get as close as possible to being cutting edge. The panel believed that at some point the cost associated with merging technologies may be more expensive than just replacing it outright. As the price for new technology comes down there will be a push to more frequently use the best product on the market. The panel rated the concern for this trend an eight. They felt that if agencies spent significantly in this area it may delay the advancement of technologies for a satellite repeater.

An analysis of the panel's trends showed that even with increased support for public safety communications the general public had its limits on what type of personal impact they were willing to accept. The amount of increased funding availability was also of concern but only where the dots were easily connected with public safety. The panel also revealed that there would be an increase in the number of public safety agencies looking to satellite technology over the next ten years.

<u>Events</u>

After the trend analysis, the panel was next asked to identify possible events that could impact the issue statement. An event is defined as: a **specific** incident that could occur in the future which would possibly impact a particular issue. Events are different from trends in that events are singular occurrences, and happen at a specific time and date. The panel again was put through a round robin exercise to ensure

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participation. After three rounds the panel generated twenty-seven events (Appendix C). The group was led through the prioritization process where they identified the top eight events that they believed would have the greatest impact on the issue statement.

EVENT	YEAR >0	+5 YEARS	+10 YEARS	IMPACT (-10 to +10)
E1 Solar flares disrupt communications world wide	10	0	10	-5
E2 Wireless networking bandwidth increases to multi-megabit speeds	4	50	90	+5
E3 Hackers develop technology to shut down satellite technology	5	50	90	-9
E4 Large meteor shower knocks out satellite communications	7	0	12	-7
E5 Enemy military attack on US space installations	15	0	0	-7
E6 Richard Branson successfully launches a reusable rocket twice	7	0	70	+5
E7 State legislation passes law to protect local budgets	1	50	50	+5
E8 Federal legislation is passed to require that objects put in space must be retrievable	10	0	50	-2

Event Table
Table 2.2

The top eight events and their corresponding median values given by the NGT panel members are reflected in column 1 of Event Table 2.2. The facilitator guided the panel members to assign numerical values in columns 2 through 5. In column 2, the panel assigned a time frame greater than "zero" when they thought the event could first

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occur. In columns 3 and 4, the panel provided what they felt was the probability expressed in a percentage the event would occur within two specific time periods. These time periods were within the next five years and within the next ten years. The NGT panel was given clarifying instructions as to if they gave a date greater than the respective time frames, that the percentage chance would be 0. For instance, if the panel member said the event would occur in the sixth year then the percentage chance of it occurring within five years would be zero. In addition, the panel was also instructed that the percentages could not go down in column 4, (within the next ten years), from column 3, (within the next 5 years).

Panel members were lastly advised to rate from 1 (low) to 10 (high) in column 5, on the level of impact, positive or negative, the event would have on the issue. They had the following discussions in summary as to the top eight events.

Event 1 - Solar flares disrupt communications worldwide

The panel advised solar flares could be a problem for a satellite repeater system. A panel member explained that solar flares occur when magnetic energy that has built up in the solar atmosphere is suddenly released. This release causes the Earth's upper atmosphere to be more ionized and expansive. Long distance radio signals can be disrupted by the resulting change in the Earth's ionosphere. A satellite's orbit around the Earth can be disturbed by the enhanced drag on the satellite from the expanded atmosphere and a satellite's electronic components also can be damaged. Though the panel had no specific knowledge as to any significant communication disruption solar flares have caused to date, they believed this type of event would have an impact and should be looked at. The panel discussion broadened into the general disruption the sun

may have and its effect on technology used in space. The panel felt the use of a vital communication technology in space would need to take these events into consideration and provide for any mitigation or back-up measures that may be needed to prevent any disruption. The panel felt this event could happen, though they only gave it a 10% probability of occurring in the next 10 years.

Event 2 - Wireless networking bandwidth increases to multi-megabit speeds

The panel's median score indicated that this jump in technology had a 50% probability of occurring within the next 5 years and were almost certain (90%) it would happen within the next 10 years. The panel believed that these bandwidth increases would initially be another option to satellites and may slow the turn of those agencies needing the infrastructure to support their use of wireless transmissions of large data files. The panel, however, felt that this would ultimately be incorporated into satellite technology and positively enhance the overall speed and capacity of a satellite repeater system, thus they rated it a positive five.

Event 3 - Hackers develop technology to shut down satellite technology

The panel had initial disagreement on this issue. The panel members argued over the abilities of computer hackers to actually shut down a satellite-based system. The group felt that if this were possible it would have already happened. Also, some felt that even if a hacker could break into a remote system, they would only have minimal impact on a repeater system. The group eventually came to the conclusion that as time goes on,

the possibility of a "hacker event" occurring would significantly increase (90%) within the next 10 years. The group also rated this event as the most significant negative event (-9) as it relates to impacting a satellite repeater system.

Event 4 - Large meteor shower knocks out satellite communications

The panel believed that meteor showers were a common event. The panel initially felt satellites would be vulnerable to damage or failure and could cause a total shutdown of an agency's communication system until the satellite was fixed or replaced. As such they believed that it would be very risky to rely totally on a satellite repeater system for public safety radio communications. The panel eventually changed this opinion after discussing the amount of time satellites have been successfully used. The panel members also could not recall or had no knowledge of any documented occurrence where a meteor shower had damaged any item in space. The panel eventually gave this event no chance of occurring within the first five years and only a twelve percent chance before ten years. The consensus was that this had already been considered in the use of satellites repeaters and as such there are redundant systems in place to account for any type of damage a meteor shower may cause. The panel did rate this as a significant negative (-7) if a meteor shower were to knock out a communication satellite system.

Event 5 - Enemy military attack on United States (US) space installations

The panel was split about this event with some believing that it was a distinct possibility it could occur within 10 years, though the median year occurring was 15 years. Panel members discussed the role of satellites and how they have provided a significant

advantage for the US in communication and surveillance against other countries that did not have this technology. The panel added that during times of war or conflict the military has used this technology to provide intelligence (visual or audio) as to what their opposition was doing. The panel next discussed how other countries either had made or were making technological advancements in rocket guidance systems. Some panel members felt these two sets of circumstances would create a situation where countries involved in a conflict with the US would design a plan to attack and destroy US space assets. As such, the panel concluded that if an enemy military were to attack military space installations, they included assets such as satellites in this argument, they felt it would be a significant negative and thusly rated it a negative seven. While the median year was not likely to occur within fifteen years, the panel members felt this event was important to include.

Event 6 - Richard Branson successfully launches a reusable rocket twice

Panel members explained that Richard Branson was the multi-billionaire owner of companies such as Virgin Airlines and Virgin Records. They described him as a thrill seeker who had made several unsuccessful attempts to travel around the world in a hot air balloon. Mr. Branson had staked a $10 million prize for anyone who could design a manned spacecraft that could travel to the edge of space on back-to-back flights. After the discussion was held regarding who Richard Branson was, the panel felt this event had a 70% chance of occurring within the next 10 years. The discussion was based upon the amount of money that Branson was offering for the accomplishment and the increased desire by the wealthy and celebrities to travel in space. The group discussed the need for

advancement in the space shuttle program and that an event such as this would create the push needed for this to occur. All of this would have a positive impact (+5) on the issue statement.

Event 7 - State legislation passes law to protect local budgets

The panel felt this could occur in the next year, though they were not overwhelmingly confident that it would occur. The discussions felt that the likelihood was that it would occur sooner rather than later and that the chances of it occurring would not increase with time. The panel discussed that a reliable budget was needed for local governments to plan for any large undertakings such as what was proposed in the issue statement. Overall, the panel felt that this was a moderately positive for the issue statement.

Event 8 - Federal legislation is passed to require that objects put in space must be retrievable

As more technology and equipment is put in orbit around the earth, the panel believed the push for this legislation will intensify. The primary discussion focused on satellites and the need for specific positioning and unencumbered orbits. The panel also felt that as more communication technology is placed in space, interference by neighboring devices may also cause the need for this legislation. The panel gave some varying ways that removal could occur including sending the item out of orbit and into space and controlled descents into the ocean. The second option caused additional discussion of impacts that this type of technology would have in polluting the ocean. The

panel felt this legislation had a 0% chance to pass by the five year mark and a 50%

chance to get passed in ten years. The panel felt this event would have a minor negative

impact (-2) on the issue statement.

An overall look at the events identified by the panel members indicate their belief

that technology will continue to improve, E-6 (reusable rockets), E-2 (bandwidth), which

will be a positive to the issue statement. Along with this, however, will continue to be

hurdles that will need to be overcome, E-3 (hackers), E-7 (local budget), E-8 (retrievable

objects), for the issue statement to become a viable option for law enforcement.

Cross Impact Analysis

The next phase of the NGT process was the cross impact analysis of the trends

and events. This analysis enabled the panel to rate how the eight events would impact the

eight trends. The impact was measured on a scale of one (low) to five (high) and if it

would be a positive or negative impact. Zero was used if the panel felt the event would

have no impact on the trend. The scores were again converted to median values and are

represented in table 2.3.

TRENDS								
EVENTS .	**T1** Comm funding	**T2** Agencies looking	**T3** Reliability	**T4** Budget levels	**T5** Bandwidth	**T6** NIMBY	**T7** Funding	**T8** Tech merg
E1 Solar flares	+1	-1	-1	0	0	-1	+2	+3
E2 Bandwidth	+2	+1	+1	0	+5	+2	+1	+2
E3 Hackers	+1	-2	-3	0	0	-2	+2	-3
E4 Meteor shower	+3	-4	-4	+1	-2	-3	+3	-1
E5 Space Attack	+1	-1	-2	-2	-2	-1	+3	-1
E6 Branson	0	+2	+3	+1	0	+2	+2	-2
E7 Local budgets	0	+1	0	+5	+2	-1	-1	-1
E8 Retrieval	-1	-2	-3	-1	-1	-3	+3	+2

Cross Impact Table
Table 2.3

An analysis of the panel's scoring and discussions indicate there were events that would have a significant impact on the trends. The following is based upon the scores in Table 2.3, and the discussions of the panel.

The panel felt that if bandwidth were to significantly increase its speed (E2), then it would be the catalyst to significantly positively affect, on the short term, the demand for bandwidth (T5). The short-term view of this event was due to the belief that what is fast today is slow tomorrow. However, the faster bandwidth speed would greatly enhance all areas of data and radio transmissions. In their impact analysis of how a

catastrophe such as a meteor shower knocking out satellite communication (E4) would impact the number of law enforcement agencies looking at this form of technology (T2), the panel felt it would be a significant negative impact. Any major incident where technology such as satellites are compromised to the point where they would become inoperable should give a chilling effect as to wanting to use that form of technology. As satellites are a significant distance, and there would be no easy and fast way to fix them, significant reliable redundancy would have to be in place. The use of multiple satellites was a recommendation to solve this problem. The event was also a significant negative as to the overall feeling related to space technology reliability (T3). The fact that satellites have been in use for several decades, and the panel could not recall anything occurring such as this, the group did not have a high degree of fear that this event could occur. The group did express an overall feeling that events such as the made up meteor shower and even the real space shuttle disasters created, for the most part, short-term lack of confidence towards technology in space.

The panel did believe the passage of legislation that protected local budgets (E7) would have an overwhelming positive impact on local budgets (T4). The group felt that this legislation would create more stable local government planning, where they could do actual long term planning for major projects. This included taking on projects such as looking for communication infrastructure alternatives such as a satellite system.

The Cross Impact Analysis did reveal that two events (E2) bandwidth speed improvements and (E6) successful reusable rockets almost uniformly positively impacted the top eight trends.

Scenarios

Providing multiple futuristic scenarios based upon information derived from the NGT panel, literature review and environmental scanning is an opportunity to look at possible outcomes of implementing the proposed issue statement. In addition, viewing three different scenario perspectives: pessimistic, optimistic and surprise free, gives an opportunity to prepare for alternatives when attempting to plan for implementation of strategies related to the installation of a satellite repeater system.

Pessimistic Scenario

The United States was saddened today, December 7, 2009, as another space shuttle was destroyed while attempting to place the nation's first law enforcement communication satellite system (CSS). CSS was funded through significant funding supplied by the Office of Homeland Security through grants to the Sacramento Police Department. In compliance with new federal laws, and as a cost saving measure for the police department, the shuttle crew was performing a retrieval of an older satellite after it had placed the new CSS-3000. This new satellite would have provided the Sacramento public safety community with its fastest and most efficient repeater system to date. The shuttle and new satellite were both destroyed as an undetected meteor shower literally cut the shuttle into three pieces and ripped apart the new satellite. This tragedy, the first for the new Branson Shuttle Service (BSS), put a death nail into the funding that was headed to the establishment of a truly reliable space based radio system for law enforcement.

Sacramento law enforcement officials had tied their hopes to the CSS as new federal legislation prohibiting the installation of land-based repeater towers has created

an urgency for the entire public safety community to find viable alternatives to current land-based systems. This disaster, coupled with the federal government taking funding from the state, and the state taking funding from the local governments, has now reached a critical peak.

This satellite repeater system was funded via the last of the Federal Homeland Security Communication Grants. With President Hillary Clinton having done away with the entire Homeland Security Department and moving their funding to her new Office of Nationalized Health Care, law enforcement is looking for new funding or another alternative.

Optimistic Scenario

Today, December 7, 2009, law enforcement agencies from around the county are hailing public safety's newest weapon in the fight against terrorism, their space based communication technology. The Sacramento Police Department, who spearheaded the push to put satellites in space, is being heralded as a true forward thinking department.

Sacramento's satellite repeater system was put to the test when they connected it nationwide to assist in a terrorist hunt and eventual capture of suspects who had almost set off a dirty bomb in Los Angeles (LA). The suspects who had knocked out several repeater and cell towers in the LA area were moving quickly when parts of their plot was uncovered by the Sacramento area Joint Terrorism Task Force (JTTF). The JTTF immediately connected with the officials in LA and restored emergency communication in the LA area. Sacramento's satellite was outfitted with the latest technologies, the fastest and largest multi-megabit bandwidth and software solutions that allow interface with other radio systems. In addition, with the twin satellites 22,000 miles in space, the

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JTTF was able to immediately converse directly with LA patrol units on the ground to foil the terrorist plot before it unfolded.

Sacramento's twin satellites were launched almost a year earlier and were funded via Homeland Security grants in addition to local funds the police department was able to secure as part of its Joint Powers Authority (JPA) in the region. Significant funding increases were added to the satellite project in part due to the passage of legislation that prohibited the state from raiding local revenue. Local community groups and environmentalists hailed the project as the cutting edge of a national wave of both private and public agencies taking down their repeater towers. With the passage of NIMBY repeater tower legislation most public safety organizations have turned to where the Sacramento Police Department has already gone. The President of the United States, Condoleezza Rice, personally praised the men and women who stopped the terrorist plot and the chief of the Sacramento Police Department for their risk-taking in making this satellite system a reality.

Surprise Free Scenario

Today, December 7, 2009, the Sacramento Police Department and its Joint Powers Authority (JPA) partners officially gave notice that they are delayed in the completion of the region's new radio and data communication system. The latest delay came as the result of another round of litigation over the erection of repeater towers needed to support the region's system. Law enforcement ran headfirst into the community they serve, who opposed the "land grab and tower eyesores." Sacramento police officials claimed through their attorneys, they had no choice but to file with the

courts and attempt to take the land by imminent domain. This land was to be used to erect their repeater towers in established neighborhoods in order to get the necessary coverage to support the system.

Community leaders, environmental groups, and elected officials stood together in an effort to stop Sacramento's public safety multi-tower site acquisitions needed to support their new radio system. Community leaders were angered as they felt their input into the process was ignored and promised to fight the seldom-used imminent domain process. City leaders were at a loss to come up with a viable option in the media, however unnamed officials advised that they underestimated the level of backlash this latest court action would cause and probably would look to alternatives.

JPA officials refused to discuss other options they may have, as they cited pending litigation. An unnamed JPA official advised that they had another proposal on the table earlier in the planning process which would have avoided the litigation that is now on-going. This proposal would have used satellites to replace the current repeater system. This unnamed official claimed other JPA members rejected this outright as untested, but as they now know, with CHP's new system in place and becoming the wave of future thinking agencies, it was a very viable alternative. CHP officials refused to comment on the record, but are reported to have offered Sacramento officials a place on the system but they were rebuffed.

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Summary

Though the scenarios presented in this project are made up, they give opportunities to ponder different futures. Basing the scenarios on information obtained in the NGT process, literature review, and environmental scanning help shape the scenarios so they are at least based upon research centered on this project. They help illustrate, for individuals responsible for the planning and implementing of a project, the importance of taking a close look at emerging trends and how events will have an impact on the direction they will go. They also help emphasize the important role strategic planning has to preparing for the future. The next chapter will lay out a strategic plan for this project.

CHAPTER THREE

STRATEGIC PLAN

Introduction

A strategic plan is a structured process to provide planning and decision making for the future. It provides for a roadmap from today to an anticipated vision of the future. The plan is both objective and subjective and allows room to think creatively. The strategic plan process enables an organization to think into the future so that it can prepare for the obstacles it may face and to plan contingencies accordingly. It also provides a process for critical decisions today that will affect the future allocation of resources with the intent of making the organization successful. A strategic plan's ultimate purpose is to increase an organization's chance of having a successful future with desirable outcomes. It will not ensure success, but will provide a direction for the entire organization to understand and follow.

The strategic plan for this project will define strategies for a large urban agency with the goal of implementing a satellite repeater system for its communications by 2009. The optimistic scenario of Chapter Two will be used to develop a strategic plan. The setting of a lofty goal with high expectations is more preferable to strive for than the alternative.

Organizational Description

The City of Sacramento is the capital of California. California has the largest state population in the United States and the seventh largest economy in the world. By

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population, the city of Sacramento is the eighth largest in the state. Incorporated in 1849, the city is over 100 square miles in size and is home to a diverse population of over 450,000 residents. The city has a full time mayor and eight part time city council members. These elected officials appoint a city manager to lead and handle the operations of the city. The region is home to technology companies such as Intel, Hewlett Packard, and Oracle.

The Sacramento Police Department is staffed with over eleven hundred employees, in both the sworn and civilian classifications. A chief of police, appointed by the city manager, leads the department. The department is organized into five major components called offices, which are managed by two deputy chiefs. The department has an annual budget of 100 million.

The Sacramento Police Department has long been recognized in the area of community oriented policing and its efforts involving the community. The department is gaining a reputation of investing in and using technology to improve its efficiency and effectiveness in crime fighting and delivering service to its community and the region. Some of its more notable uses of technology include:

✓ A video downlink from its air units to its supervisory vehicles, intranet, emergency operations center, the fire department, and to its City Manager and elected officials.

✓ A real time records crime analysis system that allows for critical deployment of police assets to deter and capture criminals.

✓ Issuing tasers to its sworn line staff.

- ✓ Installing an Automated Vehicle Locator (AVL) system on its patrol fleet for "proximity dispatching" to decrease response times to calls for service.
- ✓ Public internet access to the cities registered sex offenders.
- ✓ Public internet access to crimes information for neighborhoods.
- ✓ Mobile field reporting for crime and collision reports.
- ✓ Mobile Law Enforcement Automated Data System (LEADS), in a partnership with Hewlett Packard and the Department of Corrections, the department is able to transmit LEADS data to its field units Mobile Data Computers.
- ✓ Cal Photo, in a partnership with the Department of Motor Vehicles the department is able to access the DMV photos with its field units Mobile Data Computers.
- ✓ Participation on a Joint Powers Authority (JPA) for the region for radio communication procurement and interoperability.

The department is currently upgrading its information and dispatching technologies through a multi-million dollar Community Oriented Policing (COPs) grant. This upgrade will allow the department to capture, catalog, and retrieve additional information, which in turn will free up personnel time to focus on other duties and improve the crime analysis for officer deployments.

The department has twenty-seven full time staff dedicated to its technology research development, implementation, and servicing. The department also has a part-time paid technology consultant from Hewlett Packard who assists in the integration of the department's data and communication technologies. (The consultant is the highest paid employee in the city).

The Sacramento Police Department has been a lead regional partner for radio and data communications since 1991. The regional JPA approach has created a radio system that allows for immediate interoperability during emergency situations. It also allows for increased spending power, better planning, and an opportunity to purchase the newest most efficient and reliable communications systems available. With the current system the JPA creates standardization for the region yet it allows for parts of the system to be tailored for the individual departments involved.

An example of the standardization is that all agencies utilize like equipment and can operate on each other's talk groups. These groups are divided amongst the JPA agencies and then again by each agency to address their individual needs. Each radio can be reprogrammed as needed for the system and by the individual operator, depending upon the needs of the assignment or situation and can be used for all of the talk groups. In the instance where mutual aid is needed, the technology is there to provide interoperability.

An example of the tailoring ability of the system is primarily in the data transmissions it allows. Each department uses the radio system to transmit its data either in the form of dispatching text information, records management systems, or a variety of other data links. These vary greatly by the JPA agencies. The Sacramento Police Department's investment in data technology far exceeds its partners in the region. The department uses the radio system to send data that its partners do not have the ability to send. Therefore, even with the standardization, each department has the ability to pursue its own interest in technologies it seeks to invest in for its staff and community.

A mission, vision and values statement was derived for this project's strategic plan from the current Sacramento Police Department's. It was modified for the purposes of supporting the issue statement of this project. The mission statement describes how the department will work in partnership with the community to enhance the quality of life in the city of Sacramento. The vision statement demonstrates the department's commitment to be futures oriented. The value statement is a reflection as to the core belief's of the men and women of the department.

Mission Statement

The mission of the Sacramento Police Department is to work in partnership with the community to protect life and property, solve neighborhood problems, and enhance the quality of life in our city while striving to become more efficient through the use of emerging communication and data technologies.

Vision Statement

The Sacramento Police Department is an organization dedicated to the leadership of law enforcement into the future. The department strives to be prepared for the future through forward thinking and embracing change. The department is dedicated to working smarter through new technology to enhance its abilities and to provide efficient and effective law enforcement services to the communities it serves.

Values

As members of the Sacramento Police Department, we accept responsibility for contributing to the quality of life in our community. We believe the character of our

Department is best reflected in the quality of service provided by each of our members. We will meet the challenges to provide quality through our shared values and commitment to:

- Serve in an impartial, courteous, responsive, and effective manner.

- Maintain an attitude that respects the dignity and rights of those we serve.

- Facilitate open communication with our community.

- Support inclusion and diversity in our organization and in our community.

- Professionalism, which is the result of a clear sense of perspective and direction, strengthened by teamwork and innovation.

- Remain enthusiastic and put empathy first in the public and employee relations.

- Promote community harmony, cooperation, and involvement.

- Be ever mindful that we are members of the community that we serve.

Situational Analysis

This process involves the objective inventory of the organization's internal strengths and weaknesses coupled with the environmental opportunities and threats (S.W.O.T.). The SWOT model will be used in the implementation strategy for a satellite repeater system.

Internal Strengths

- Culture and desire to break new ground in technology

- JPA already in place for communication technology

- Ability and track record in working with others

- Ability and success at locating and securing grants

- A large agency with personnel and resources to dedicate to the mission

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Internal Weaknesses

- A limited budget

- No expertise in satellite technology

- Convincing the JPA to take the risk in this technology

- Currently involved in multiple departmental technology upgrades

- Recently required to upgrade fire department's technology

- Limited authority by appointed agency head

Environmental Opportunities

- Military using satellite technology for radio system

- Satellite commercial radio becoming more mainstream

- Interoperability grants are available

- Regional radio system is in need of upgrade

- New repeaters (land and technology) needed for regional system

- New high-rise developments being planned for community

Environmental Threats

- Multiple agencies need to agree to proposal

- Elected officials may object to project

Stakeholders

Identifying stakeholders and analyzing their specific concerns and expectations is crucial to the planning process. Stakeholders are individuals or groups who may be impacted by or may impact the actions of any organization attempting change. The relationship of the stakeholders and department can positively or negatively affect change depending upon their perceptions and actions. Getting the buy-in, either formal or informal, of identified stakeholders is necessary for any organization to have a positive outcome. The following twelve were identified as stakeholders who could assist or impede in the implementation of a satellite repeater system. Included in the twelve is a possible snail darter or surprise opponent. A snail darter is a term that has come to mean opposition from an unanticipated source. Following each stakeholder is a list of concerns or issues each may have. Next to each stakeholders title is the position they have towards the project provided their concerns or issues are addressed.

1. Chief of Police (Support)

   - Wants to be the first in innovations in law enforcement

   - Will hold those accountable to ensure that the system works

   - Will want the media as part of the marketing

   - Will want the project on a timeline

2. City Manager (Support)

   - Will want to know the budget impact, short and long term

   - Will want to know the funding source

   - Will want assurances that it will work

- Will want the JPA to endorse the idea publicly

- Will want the local elected officials to support publicly

- Will want to know all of the benefits and shortcomings

3. Elected Officials (local, state, federal) (Indifferent)

- Will want to know the budget impact (local)

- Will want to know the benefits to the community (local and state)

- Will want assurances on the total costs (local)

- If there are cost overruns, will want to know where the money will come from (local, state, federal)

- Will want a degree of separation if project fails

4. JPA (Support)

- Will want a unanimous agreement from the members

- Will want to have a technical advisor/consultant in the satellite field as part of the project

- Will want to ensure of enough funding to support the project

- Will want a timeline as to having the system operational

5. Data Services Division (Support)

- Will want additional staff with experience in satellite communications

- Will want to hire consultants in the satellite communication field

- Will want funding for additional training

- Will want a back-up system until satellite system is proven

6. Grant Providers (Support)

- Will want assurances as to the viability of a satellite system

- Will want a degree of matching funds

- Will want support from multiple layers (local, state, federal) of elected

officials

- Will want a detailed plan and financial information that will demonstrate

  the ability to be successful in the project

- Will want a timeline for completion, with milestones

7. Sacramento Police Officer's Association (SPOA) (Indifferent)

- Will want to ensure the funding is not being taken from officer staffing

- Will want to ensure that the funding will not impact labor negotiations

- Will be concerned as to officer safety for their employees until system is

  deemed reliable

8. Media (Support)

- Will want to be have a spokesperson for the project

- Will want to have visuals for presentation (television & print)

- Will want to have regular updates

- Will want to know how it is being funded and exact costs

- Will want specific details for sound bites

9. Community (Indifferent)

- Will want to know how much it will cost

- Will want to ensure that other projects were not sacrificed to pay for

system

- Will demand the project is reliable

- Will want to know what they are getting from the system

10. NASA (Indifferent)

- Will want to determine where satellite will be placed

- Will want to know how satellite will impact other satellites

- Will want to know timeline of satellite readiness as it relates to scheduled launch of shuttle

11. Satellite industry (Support)

- Will want the project to be successful

- Will want the agencies involved to be reliable

- Will want to ensure the agency has enough funding

12. Sheriff, Sacramento County (possible snail darter)

- Current sheriff, who is part of JPA, is at the end of term and not seeking re-election

- Current political debate over the need to appoint versus elect a sheriff

- May reject any major project that is originated by an appointed law enforcement chief

- Current budget issues and incorporations of portions of the county may cause sheriff to impede any regionalization of resources

With the exception of the elected officials, SPOA, the community, and the possible snail darter the remainder will support this project provided their issues and or

concerns are addressed. At a minimum, with their concerns and issues addressed, the listed stakeholders should be indifferent to this project.

Strategy Development

As part of the strategic plan, it is important to develop alternative strategies. It is important to weigh different alternatives before moving forward with a proposed change such as this project. The following are the four principle options outlined for this project.

Strategy one: Status quo

Status quo is by far the simplest course of action. It requires no risk taking or leadership. This option though fails to expand upon an already successful organizational structure in the regional JPA. It also moves the window of opportunity out for a significant change in any infrastructure due to potential expenditures for smaller advancements on the current communications technology.

Strategy two: Research and wait

This strategy takes a little more work than status quo but requires minimal immediate action. Leaders using this strategy acknowledge the importance of the issue but choose to wait for someone else to go first. This process is a safer approach then full committal and allows for evaluating others work. The risk taking is at a minimum and so is the leadership. However, depending on the amount of research and outreach done by

the leaders, this strategy can bring the need for change to a higher level of awareness and can create a since of urgency or need sometime in the future.

Strategy three: Regional approach to develop a plan for moving to a satellite repeater system

In this strategy, the leaders of the JPA organizations recognize the opportunity and importance of moving forward to make a significant advancement in communication technology. This strategy will require the JPA leadership to articulate a need for change and a vision of the future desired state. They must work to obtain support from the stakeholders and develop strategies to overcome impediments. There is significant risk with this strategy, as going first is in any venture. The amount of supplemental funding needed will be great, but as the agencies in the JPA are large, located in the capital city of the most populous state and have relationships with significant influential politicians they have an good opportunity to reach the desired state.

Strategy four: Statewide approach to develop a plan for moving to a satellite repeater system

This strategy takes the most effort and has significant advantages in the amount of potential funding. This strategy embraces the need to bring agencies together to have a statewide radio system. The amount of stakeholders for this strategy is large and will have the potential for more roadblocks. This strategy will require collaborative leadership and a shared vision to succeed. It will require the elements in strategy three but on a grander scale.

Strategy three is the preferred course of action to reach the desired state. This strategy requires the JPA leadership and the Sacramento Police Department to take a lead role in creating a common vision for the involved organizations and stakeholders. Though strategy four has a larger pool of law enforcement agencies to draw from for funding and staff, it also has too many potential roadblocks. At a minimum, starting with strategy three will enable a more streamlined and established organization (JPA) to research and work out the details in the event a larger group is desired.

Implementation Plan

The Sacramento Police Department will coordinate the implementation of this plan. Having an established JPA for the region allows for a partnership base of agencies to assist. Having the support of the leaders of the JPA is key to even beginning the project. Therefore it is paramount that the JPA understands the vision of the project and the desired future state. The chief of police will be responsible for this step. The JPA will be taking a risk in pursuing this technology and will need to educate their respective agencies as to the long-term benefits of moving to satellite based technology. Having several agencies in the public safety sector (police, sheriff, fire and EMS) will allow for a diverse working group committed to the plan. These leaders must have the authority to make decisions as the plan evolves. As the designated lead in the implementation, the Sacramento Police Department will be charged with assigning the committed personnel to respond to issues and will designate responsibilities of any needed task to accomplish the mission. The department will manage the project using an incident command

structure with the chief of police as the overall commander of the project, but will also include a specific project manager for day-to-day decisions.

Once the JPA leaders are ready to move forward, the vision of the project will need to be conveyed to the stakeholders. The JPA will work on strategies for the listed stakeholders and then coordinate a meeting between the JPA leaders and leaders of the respective stakeholders. The JPA leaders will address as many questions and issues as possible to gain their support. The success of implementing a satellite based communication system depends on the strength of commitment from the top. Having the chiefs (police and fire), sheriff, and head of EMS seek a commitment to the project personally will strengthen the stakeholders overall support for the project. It will be important for the JPA leaders to seek input from the stakeholders so they know they are part of this project. It will also be important that those stakeholders attending will have the authority to make decisions and commitments to the project.

As the implementation of a satellite communication system for public safety will be a first, there will be a need to bring in satellite industry consultants (manufacturing, launching and placement), and possibly the military. These consultants will assist in multiple areas including education, grant writing, lobbying, contract writing, and satellite designing, launching and placement.

The project manager will assign a working group to establish a timeline with identified milestones toward completion of the project. The ultimate timeline will be to launch the satellite by 2008 and to have it fully operational by 2009. The timeline will include researching the public safety agencies throughout the state to examine and catalog the different communication systems currently in use. This cataloging will be

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used to look for interoperability opportunities for the system. It will also look for possible future JPA members.

Key stakeholders, JPA members, and the satellite and military consultants will lobby for and obtain additional funding for the satellite system. During this lobbying, regular media briefings as to the project's purpose and status will occur. These media briefings will be key to assist in influencing the elected officials to support the project and push funding its way.

After the funding is secured (and possible additional JPA members are added) the project manager will harden identified timelines for transition from a land-based system to a satellite system. This transition will include: completion of the satellite's (or satellites') overall design, selection of a company or government agency for launching and placing the satellite, and an overlap period where both systems will be operational. On the launch date and when the system is fully functional, press conferences will be held with the identified stakeholders and elected officials taking the spotlight for their leadership in bringing the satellite based communications system on-line.

Finally, when the repeater system is on-line, an evaluation of the system will need to be done. This evaluation will cover the following:

- Coverage area

- Identification of dead spots

- Signal speed

An evaluation of the coverage area would involve testing the system's reception and transmission capability from various points inside to just outside the intended coverage

area. Acceptable performance would be the system having the ability to receive and transmit from these locations.

An evaluation for dead spots would involve testing the system's ability to receive and transmit next to large structures, such as a highrise building, stadium or large storage tank. Acceptable performance would be the system's ability to receive and transmit from all exterior locations.

An evaluation for signal speed would involve measuring the amount of delay that occurs when a user initially attempts to transmit on the system. Acceptable performance would be the satellite repeater system equaling the current delay of the land-based system.

There are additional elements of this project's proposed satellite repeater system that would need to be evaluated. These would include: the stability of the satellite's orbit, clarity of radio transmissions, and interference from other signals to name a few. Those discussed for this project are the minimum performance checks that should be done.

Conclusion

The most important part of implementing this plan is getting elected officials with real political power to support the project. This political power is needed to obtain the necessary funding to make the project a reality. Presenting them with a vision where a satellite system is able to support the communications needs for public safety from coast to coast is a powerful vision. The ability to be fully interoperable for emergencies, disasters, and homeland security on a national level is the macro vision. The starting

point is the micro vision at a large urban agency with the track record of making technology work.

The next step in moving the project forward is to a smooth managed transition. This transition will take the project to the desired future of a fully functional satellite communications system. It will also assist in keeping members of the working group on task and focused. As such the next chapter will cover this project's transition management strategy.

CHAPTER FOUR

TRANSITION MANAGEMENT

Introduction

A challenge for leaders attempting to move an organization from a present state to a future state is trying to do it smoothly. As strategies are prepared to move a large urban agency from a land-based communication system to an untested satellite communication system, there will need for the organization leadership to articulate a concise vision while also creating a sense of urgency.[xxi] As with any change there will be some resistance and a need to change priorities. To be successful, putting together a transition management plan is essential. There are a variety of strategies to accomplish this. This chapter will cover a commitment plan and transition techniques to address who is necessary and what tasks they will need to undertake to assist in bringing a satellite communication system on-line.
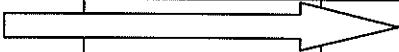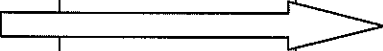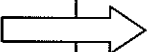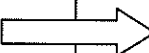
Commitment Plan

In any complex change process, there is a critical mass of individuals or groups whose active commitment is necessary to provide the energy for the change to occur.[xxii] Identifying key personnel, influential stakeholders or the informal leaders in an organization who have the ability to influence a significant number of others will build the necessary momentum to make this change successful. The following are a list of individuals or groups who are the critical mass for this plan.

- JPA leaders

- City Manager

- NASA

- Regional city councils

After identifying the critical mass, it is necessary to develop a plan that identifies where the current commitment is for each of these identified subjects or groups and where they need to be in order to accomplish the strategic plan. A commitment chart (Table 4.1) is a visual tool that helps to track this level of commitment information.[xxiii]

Critical Mass Groups/ Individuals	No Commitment	Let it Happen	Help it Happen	Make it Happen
1. JPA leaders		X ⟶		O
2. City Manager	X ⟶		O	
3. NASA	X ⟶	O		
4. Regional city councils	X ⟶	O		

Commitment Chart
Table 4.1

In the commitment chart, there are four degrees of commitment. They are:

- No Commitment

- Let it Happen

- Help it Happen

- Make it happen

The "X" in the chart indicates where the degree of commitment currently is. The "O" is where the minimum of level of commitment needs to be for the police department to change to a satellite based communication system. The JPA leaders stand out as being key to push to the degree of "make it happen" commitment. NASA will be required to help it happen as they control the placement of satellites. An analysis of the commitment chart is as follows:

JPA leaders

There is already a formalized agreement between the JPA leaders to upgrade the region's communication technology. As such, these leaders current level of commitment was noted to be let it happen.

In order to move their commitment to make it happen the JPA leaders will need to be persuaded by the benefits a satellite repeater system has to offer. Selling these leaders on the interoperability opportunities and expanded coverage would be sufficient enough to move the commitment level to the desired state.

City Manager

The city manager currently has no commitment to this project. The city manager can be persuaded to help this project if a clear vision is presented with supporting facts. Again, interoperability and coverage are key elements that will aid in moving the city manager to helping this project. The city manager is well aware of and has great concern over the city of Sacramento's susceptibility to flooding. The city manager is also knowledgeable about the importance of interoperability during any crisis. Selling the city

manager on improved and expanded interoperability will move the commitment level to the desired state.

-

NASA

NASA is the controlling government agency for placing satellites in orbit around the earth. Getting clearance to properly place the satellite(s) clearly is paramount to allowing this project move forward. NASA currently has no commitment to this project. Selling NASA on how a satellite repeater system for public safety improves interoperability and how that translates to improved national security will move the commitment to the desired state.

Regional city councils

The regional city councils currently have no commitment to this project. The council will need to be presented with a clear vision as to what a satellite repeater system will mean to their respective communities. Interoperability and regionalization are key parts of the vision that will move their commitment to the desired state.

Developing a plan to persuade or move a critical mass to a desired state is essential to moving a project forward. A key element to this plan is having a well thought out and persuasive vision that others can understand and adopt as their own.

Transition Techniques

In the transition planning, there needs to be coordinated decision making that is understood as to who is responsible for different levels of decision making. As in most organizations there are different positions that have interrelated decision making responsibilities. A person needing to purchase some form of new software system for an organization should get a level of input and decision from the person responsible for an organization's data systems in order to have a system compatible with the organization's other systems. Even though the primary decision is with the person buying the software, having this understood interrelated decision making process will make an organization more efficient with smarter decisions.

Responsibility charting is a process that has the ability to track and assess alternative behaviors for each identified person or group in a series of actions bringing about change. This charting helps reduce ambiguity, wasted energy, and adverse emotional reactions between individuals or groups whose interrelationship is affected by change.[xxiv]

Identified members of the critical mass will design the responsibility chart during a strategy meeting. The chart will include a list of decisions, actions, and activities that will affect their working relationship as a result of implementing this transition plan. A list of activities is recorded on the vertical axis of the responsibility chart. The identified critical mass or actors are recorded on the horizontal axis of the chart.[xxv]

ACTORS → DECISIONS ⬇	JPA LEADERS	CITY MANAGER	REGIONAL CITY COUNCILS	PROJECT MANAGER	NASA	SATELLITE COMPANY
Select project manager	R					
Personnel resources	S			R		
Define timeline	A			R	I	I
Lobby/obtain additional funding	R	A	I	S		
Design satellite system	I	I		A		R
Location of satellite					A	R
Set launch date				A	I	R
Press conference	A	I	I	R		

Responsibility Chart
Table 4.2

The identified members of the critical mass will decide upon and chart the desired

behavior required for each other concerning the identified decision, action, or activity

using the following classification:

- R = Responsibility – Has responsibility for action but not necessarily authority.

- A = Approval – Has the power to veto the action.

- S = Support – Has to provide resources, but does not have to agree with the

action.

- I = Informed – Must be informed or consulted before any action, but cannot veto.
- A blank space reflects that any classification would be irrelevant to the particular action.

An analysis of the responsibility chart shows that the project manager plays a key role in making this project a reality. As such, the responsibility by the JPA leaders in selecting the right project manager is paramount to the project's success.

Conclusion

This chapter discussed the need to develop a plan to transition from a current state to a future desired state or, to say it simpler, to plan for changing an organization. Having a well-thought-out transition plan is more desirable than having no plan and creating unnecessary chaos during a time of organizational change. It is important for law enforcement leaders to understand that this transition planning is also not done alone. Identifying an organization's critical mass is helpful in understanding whom the key players are who are necessary to get on board with the new desired state. In addition to knowing who these key players are, knowing where they currently stand on an issue and where they need to be in relationship to the project moving forward is a important step in figuring out what work needs to be done

The concepts of identifying the critical mass and then taking the time to get an understanding of who has what authority is important in managing a complex transition.

CHAPTER FIVE

CONCLUSION

Project Summary

This project has looked at satellites and their potential impact on law enforcement communications. Satellites are on the horizon as the next opportunity for a significant upgrading in public safety communication infrastructure. There are trends pushing for this advancement to take place, such as significant grant funding for greater interoperability[xxvi] and local community NIMBY issues related to repeater tower installation. There are also the normal roadblocks.

First and foremost of these roadblocks is funding. Nothing can take place until there is sufficient funding and this funding is not going to magically appear for a satellite repeater system. With all levels of government budgets shrinking, there has to be someone(s) with a vision who has the ability to communicate it to others who have the necessary influence or money to support this project.

A second roadblock is time. The movement to satellites for communication technology, such as repeaters, by the private sector has been occurring at a very slow pace. Satellites have been in use since the 1950s and have slowly crept to the edge of the private sector. Satellite technology is finally becoming more commonplace throughout society and appears to be making inroads to the mainstream of society. Satellites today are much like cellular technology was almost two decades ago: expensive, bulky, with large gaps in its coverage area. These issues, though, were improved upon as cellular

technology was accepted and its uses were becoming more fully recognized. The hope is that the satellite's evolution will continue and eventually replace cellular.

A perceived drawback with satellite technology is the inability to immediately service it or to put it in better context, its reliability. Part of this perceived drawback is fear of the unknown. Satellites have been around and in use for over 50 years. There are current users of satellite communications: NASA, U.S. military, global shipping companies, hikers, et cetera, that critically depend upon satellites to be reliable. Satellites have provided and continue to provide safe reliable communications and are advancing technologically more into the mainstream with commercial radio channels.

Answering the issue statement of, "How will a satellite repeater system impact radio communications in a large urban agency by 2009?" is not simple. The impact of a satellite system on the agency itself would be minimal and cost prohibitive if the agency were the only one to use this technology. Much like an individual using proprietary software where they are the sole user, these benefits are significantly less than if it were software used by the masses. Using Microsoft Word is much more productive than using "Bob's Word Processing" software. Even if Bob's is better, having software to communicate with others outside of the individual agency or business will result in a more productive organization.

This project however envisions the following as the specific impacts that the proposed satellite repeater system could have:

> Law enforcement works together with the private sector and the military to develop the next generation satellite communication repeater system.

- Public safety improves its interoperability not only regionally but statewide.

- Law enforcement helps improve communities by removal of towers used to support repeaters.

- Law enforcement uses less tax dollars due to its working together.

- Law enforcement makes future radio systems in urban environments less impacted by high-rise developments.

Having more agencies using the same communication system could begin a trend of looking to group other systems together. Much like interoperability of radio communications, having data bases with larger pools of criminal information would have a positive impact on the ability of law enforcement to locate and respond to crime series or patterns that cross jurisdictional lines. With criminals moving into high tech, law enforcement will need to gear up on how they are going to apprehend criminals that commit crimes while sitting in their home hundreds of miles and potentially several states away (not to mention the international implications). That, however, is a topic for another research paper.

This project also outlined strategic and transition management plans that can be used to make satellite communication technology a reality for law enforcement. The move to this technology though would be very complex and take a committed effort by a variety of stakeholders, government officials and the private sector.

Recommendations for the Future

The first step in moving forward toward the vision of using satellite technology is getting the idea out there for discussion. Research papers such as these get different discussions going and begin to open the eyes of those who have not considered satellites in the past.

Though it is not necessarily desirable to be in a war, the military's need and use of satellite technology for its communications is also helping to move the technology forward.

It is important that law enforcement stay informed of advancements (trends and events) in satellite technology. Doing outreach now with satellite companies, the military, other law enforcement agencies, and the upper levels of government will help move satellite technology into the realm of being possible.

Implications for Leadership

Being the first to articulate a vision of implementing satellite communication technology in public safety may be risky. It will require the use of resources (staff, time, money) to thoroughly research and explore where the state of satellite technology is now and who are the specific stakeholders that will need to be brought together to make it a reality. This type of resource investment comes with the potential for failure and criticism. Leadership though is about risk taking, so it will take a true leader to move this vision forward.

Cost Analysis

As has been discussed in this project in several areas, financial costs will be the determining factor in the ability to make satellite communications a possibility. Though no hard costs were given, the costs associated to make satellite repeater technology a reality for an individual municipal agency would be unrealistic ($100 million plus). Having a JPA established with several large agencies helps to spread the cost and scope of the project to a more realistic size. Though the size of the agencies and JPA makes the project more realistic, it will still require significant federal funding to make it a reality.

Conclusion

Public safety's responses to significant events, whether catastrophic or just large scale, have proven the need for agencies to work together, not only physically but technologically, to be successful. The time of going it alone with communication technology is coming to an end. Government budgets and expenditures are looked at with greater scrutiny and with more sophistication than ever before. As different agencies' communication technology ages out, the push for communication interoperability becomes a mandate, satellite technology becomes more affordable and more mainstream, the movement to a satellite repeater communication system can become a reality.

Nominal Group Panel Members

1.   Penny Adams   Sacramento Regional Fire Emergency Communications

2.   Richard Green   Executive Director Stockton Blvd Partnership

3.   Daniel Hahn   Sacramento Police Department

4.   Lance Hawkes   Senior Systems Engineer for Data Services

5.   Dave Johnson   Sacramento Police Department

6.   Brian Louie   Sacramento Police Department

7.   Terry Murray   City of Roseville

8.   Don Root   Office Of Emergency Services

9.   Ken Stuber   Telecom Engineer

List of Trends

1. Use of fiber optics in public safety communications
2. The merging of older communications technology with newer communications technology
3. Homeland security monies distributed to larger cities
4. The amount of funding for the space program
5. The amount of concerns over health issues related to cell towers
6. Number of terrorist incidents that have occurred in the US
7. Amount of interference from cell towers
8. Citizen involvement in land use planning
9. The level of space technology reliability
10. The higher the band of frequency, the higher the continuation factor
11. The level of support for the Patriot Act
12. The level of support for public safety communications funding
13. The accessibility for users of satellite systems
14. Amount of resistance for new cell towers
15. Level of space exploration from other countries
16. Level of NIMBY for cell towers
17. Budget levels for state and local government
18. The level/amount of "space junk" orbiting the earth
19. The amount of inter-operability between subscribers locally, nationally, and internationally
20. The amount balance between economic development and technological development in national regulatory policy
21. The demand for greater band width for different device and distances
22. Cost of system maintenance
23. Public support for funding for satellite repeaters
24. The amount of support from politicians for land-based towers
25. The price and availability of land
26. Number of agencies looking at satellites as a repeater for law enforcement
27. Hacker capabilities

List of Events

1. CA statewide major power failure (blackout) 48 hours
2. State legislation passes law to protect local budgets
3. Large meteor shower knocks out satellite communications
4. Terrorist incident knocks out national communication center
5. Stock market crashes
6. Federal legislation is passed to require that objects put in space must be retrievable
7. Suicide bombing at Union Square
8. Revolution in the US
9. FCC mandates that all LE communications is standardized
10. Iridium satellite phone system fails
11. Enemy military attack on US space installations
12. Richard Branson successfully launches a reusable rocket twice
13. Terrorist attack at the Super Bowl
14. Terrorist hijack the space shuttle and crashes into NY City (Statute of Liberty)
15. Hackers develop technology to shut down satellite technology
16. Earthquake causes CA to fall into the ocean
17. Newly incorporated cities form their own LE agencies (CH, EG, RC)
18. President cuts all LE funding
19. Mobile satellite repeater system invented
20. Successful nuclear attack on US
21. Wireless networking bandwidth increases to multi-megabit speeds
22. US government outsources all satellite launches
23. Solar flairs disrupt communications world wide

BIBLIOGRAPHY

Barlow, Edward D. "Leading and Managing in a Continuum of Change," Paper presented at Command College, Session 1, Oxnard, CA, December 12, 2002

Carroll, Chuck. *New Radio Device Puts Public Safety Agencies on Same Wavelength,* Mercury News Website. Internet. www.freqofnature.com/archives/2002_01_20_newsarchvies.html January 20, 2002.

Harris, Reuben T. and Richard Beckard. Organizational Transitions: Managing Complex Change. 2nd ed. Redding, MA: Addison-Wesley Publishing Company. 1987.

IEEE History Center. *One-Way Police Communication, 1928.* Internet. www.iee.org/organizations/history_center/milestones_photos/one_way.html May 7, 1987.

Jick, Todd J. *Managing Change: Cases and Concepts.* Paper presented at Comman College, Session 6, Oxnard, CA, December 11, 2003.

Koegel, Esq., Robert B. *Cell Tower Sitting Under the Telecommunications Act of 1996.* Internet. www.nyenvlaw.com/Koegel/cellTower.htm. Unknown.

Leeland, Steven. *Lessons in Designing LEOs: Part 1.* CommsDesign Website. Internet. www.commsdeisgn.com/main/1999/11/991/feat2.html November 1999.

Lovinger, Robert. *Rush for Cell Towers Has Slowed.* SunCoastToday Website. Internet. www.s-t.com March 16, 2003.

Office of the Press Secretary. *Press Release: Department of Homeland Security Announces Over 2.5 Billion in Grants Nationwide.* December 3, 2004.

Proc, Jerry. *Satellite Communications.* Internet www.jproc.ca/rrp/satcomm.html January 24, 1998

Sacharaoff, Deborah. *Beacon Hill Residents Protest Cell Phone Antennas.* South Seattle Star Website. Internet. www.seattlesunandstar.com July 3, 2002.

Safecom. *Recommended Federal Grants Guidance: Public Safety Communications & interoperability Grants.* Internet. www.safecomprogram.gov/NR?rdonlyres/55066F6A-A2FD-4285-AEDD-39F62EE04ADD/0/Recommended_Federal_Grants_Guidance_Public_Safety_Co mmunications_Interoperability_Grants.pdf September 2003.

Senge, Peter M. *The Fifth Discipline: The Art & Practice of the Learning Organization.* New York: Double Day. 1990

Taylor, Mary, Robert E. Epper and Thomas K. Tolman. "Wireless Communications and Interoperability Among State and Local Law Enforcement Agencies." *National Institute of Justice.* Washington DC: Department of Justice. January 1998

Uhrig, Steve. "How Far Will It Transmit?" *SWS Security, Surveillance and Communications Articles,* Internet. www.sessec.com/how-far.html October 1995

Unknown. *City Council May Tighten Cell Tower Regulations.* The Chattanoogan.com. Internet. www.chattanoogan.com January 22, 2002.

Unknown. *The Satellite Wars: Iraq, Afghanistan and Yugoslavia.* Space Today Online. Internet. www.spacetoday.org/Satellites/YugoWarStats.html 2003.

NOTES

[i] IEEE History Center, "One-Way Police Radio Communication, 1928," *Detroit Free Press* (May 7, 1987). Internet. <www.ieee.org/organizations/history_center/milestones_photos/one_way.html> Accessed January 25, 2004. 1-6

[ii] Steve Uhrig, "How Far Will it Transmit?" *SWS Security, Surveillance and Communications Articles* (October 1995) Internet. <www.swssec.com/how-far.html> (October 1995) Accessed January 25, 2004. 1-6.

[iii] Ibid, 2

[iv] Mary Taylor, Robert C. Epper and Thomas K. Tolman, "Wireless Communications and Interoperability Among State and Local Law Enforcement Agencies" *National Institute of Justice* (January 1998).

[v] Unknown, "The Satellite Wars: Iraq, Afghanistan, and Yugoslavia" *Space Today Online* (2003), Internet. <www.spacetoday.org/Satellites/YugoWarStats.html> Accessed: December 17, 2003. 1-18.

[vi] Mary Taylor, Robert C. Epper and Thomas K. Tolman, 5.

[vii] Chuck Carroll, "New Radio Device Puts Public Safety Agencies on Same Wavelenth" *The Mercury News Online* (January 20, 2002). Internet. <www.freqofnature.com/archives/2002_01_20_newsarchives.html> Accessed: January 25, 2004. 1.

[viii] Edward D. Barlow, "Leading and Managing in a Continuum of Change" (handout presented at Command College, Session 1, Oxnard, California December 12, 2002).

[ix] Jerry Proc, "Satellite Communications" (January 24, 1998) Internet. <http://jproc.ca/rrp/satcomm.html> Accessed: December 17, 2003. 5.

[x] Ibid, 10

[xi] Steven Leeland, "Lessons in Designing LEOs: Part 1" *CommsDesign Website* (November 1999). Internet. <www.commsdesign.com/main/1999/11/991/feat2.html> Accessed: December 17, 2003. 1-10

[xii] Ibid, 5

[xiii] Ibid, 8

[xiv] Ibid, 3

[xv] Unknown, "City Council May Tighten Cell Tower Regulations" *The Chattanoogan Website.* (January 22, 2002). Internet. <www.chattanoogan.com/articles/article_11111.asp> Accessed: December 17, 2003. 1-4.

[xvi] Ibid, 1
Accessed: December 17, 2003. 1-2.

[xvii] Deborah Sacharoff, "Beacon Hill Residents Protest Cell Phone Antennas," *South Seattle Star Online* (July 3, 2002). Internet. <www.seattlesunandstar.com> Accessed: December 17, 2003. 1.

[xviii] Robert Lovinger, "Rush For Cell Towers Has Slowed," *SunCoastToday.com* (March 16, 2003). Internet. <www.s-t.com> Accessed: December 17, 2003. 1-2

[xix] Robert B. Koegel, Esq., "Cell Tower Sitting Under the Telecommunications Act of 1996." Internet. <www.nyenvlaw.com/Koegel/cellTower.htm> Accessed: January 25, 2004. 1

[xx] Ibid, 2

[xxi] Todd D. Jick. "Managing Change: Cases and Concepts" (handout presented at Command College, Session 4, Oxnard, California December 11, 2003)

[xxii] Harris, Reuben T. & Richard Beckard. Organizational Transitions: Managing Complex Change. 2nd Ed. (Redding, MA: Addison-Wesley Publishing Company, 1987) 92.

[xxiii] Ibid, 198

[xxiv] Peter M. Senge. The Fifth Discipline: The Art & Practice of the Learning Organization. (New York: Doubleday, 1990)

[xxv] Ibid, 92

[xxvi] Safecom, "Recommended Federal Grants Guidance: Public Safety Communications & Interoperability Grants" (September 2003). Internet. <www.safecomprogram.gov/NR/rdonlyres/55066F6A-A2FD-4285-AEDD-39F62EE04ADD/0/Recommended_Federal_Grants_Guidance_Public_Safety_Communications_Interoperability_Grants.pdf> Accessed: September 26, 2003.